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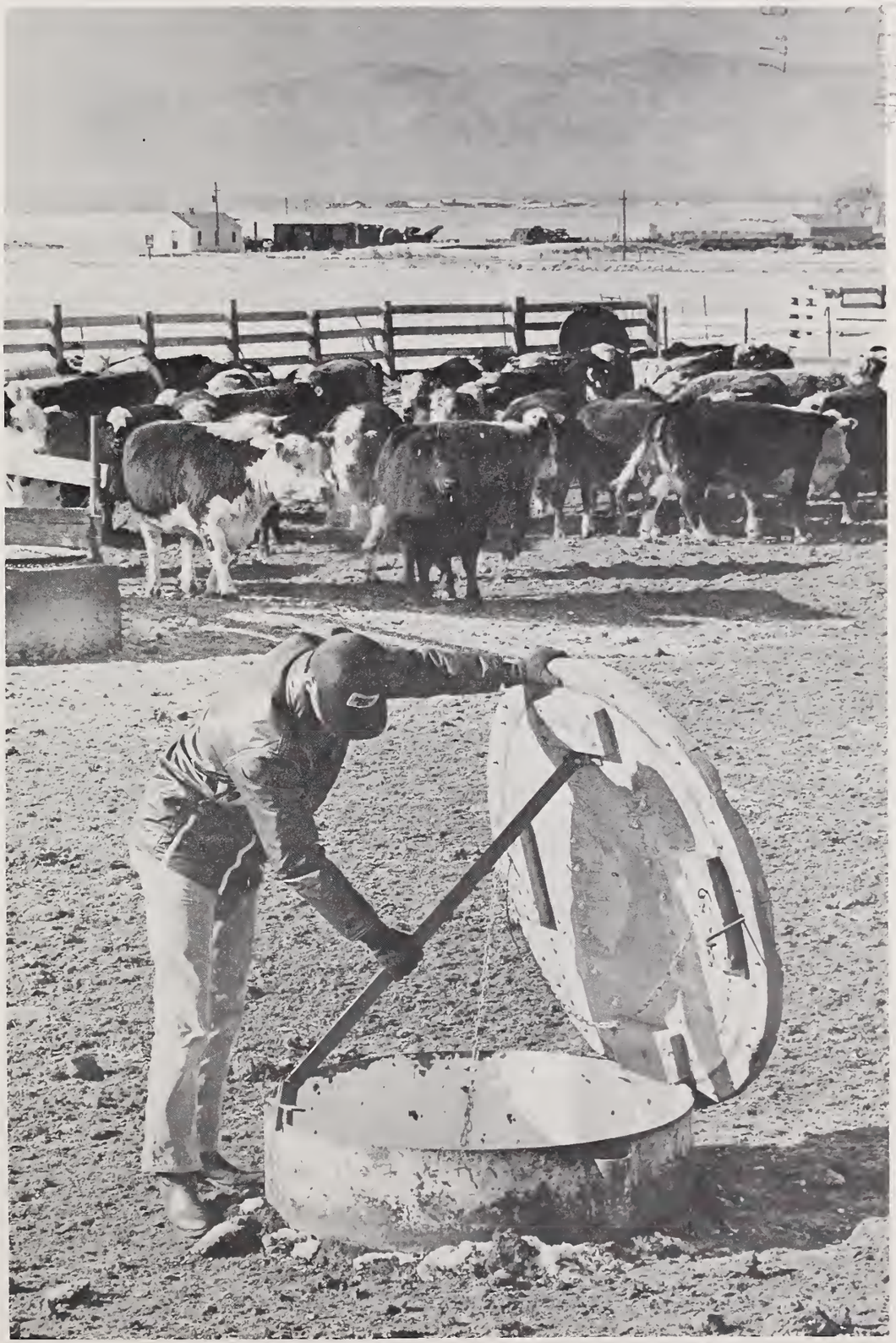
U.S. DEPARTMENT OF AGRICULTURE MAY 1975



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May 1975/Vol. 23, No. 11

Vital Careers

Americans are rediscovering agriculture. After years of being taken for granted, agriculture now makes the news headlines—whether the topic be food prices, bad weather, or a technological advance in the grim race between the stork and the plow. We have an opportunity to constructively exploit this heightened interest. Despite all the recent headlines, too many people still equate agriculture with tilling fields or harvesting crops. Unreal images, if unchanged, could diminish tomorrow's agriculture.

For agricultural progress is greatly dependent upon the achievements of scientists, one of our Nation's most important resources. We are short of this brain-power today, and each year competition grows for new graduates. Competition is especially fierce in agriculture which draws on all the sciences. Indeed, in recent years there have been about twice as many jobs as graduates.

Urbanization aggravates the problem. With each passing year there are more youngsters who have never visited a farm, much less grown up on one. If we are to continue our progress in agriculture, a good many of tomorrow's scientists and engineers will have to come from the urban and suburban communities where some 75 percent of our people live.

Agriculture must sustain an aggressive recruiting campaign to meet its manpower needs in quantity and quality. Fortunately, the colleges of agriculture are reporting sharp increases in enrollment. But efforts must get underway to recruit agriculture its share of gifted students. Ideally, these efforts should be directed at high school students whose career choices are still open. Our readers, both in and out of ARS, can play important roles in their home communities. How? By seeking out bright students who like to probe for deeper meanings, who ponder causes and consequences, and then challenging them to a lifetime of service in vital careers aimed at producing more food for a hungry world.

Teachers, for example, are in an excellent position to encourage students who show promise. Scientists everywhere can participate in their local high school's Career Day, or prepare informational materials to help guidance counselors give students a more factual picture of the many science careers open in agriculture. Indeed, all of us can help narrow the information gap on science careers in agriculture, whether by speaking before civic groups, by button-holing the local newspaper editor, or most important of all—by encouraging the apt young people we meet in our daily lives to prepare for satisfying careers in research.

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COVER: Research assistant William R. Hand opens and secures the lid of a cased dry well prior to entering it to record data on infiltration of pollutants into the soil and ground water (0275X 150–5A). Article begins on page 3.

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Intact manure packs halt seepage

ENVIRONMENTALISTS, farmers, and ranchers alike can rest a little easier now that a 4-year research project shows that cattle feedlots do not pollute soil and groundwater if there is an intact manure pack and carrying capacity averages about one animal per 200 square feet.

ARS scientists have found that an intact manure pack essentially eliminated water infiltration and movement of contaminants through the soil to the groundwater. In one level lot with a manure pack ranging from 2 to 8 inches thick and with no bedding, only 0.09 inches of water percolated through the pack into the soil in a year—0.4 percent of the 22.5 inches of water the lot received from rainfall and cattle wastes.

No water percolated through a similar feedlot with 7 percent slope. Any soil water changes that took place beneath the lots were attributed to the lateral movement of irrigation water from adjacent cropland.

ARS soil scientist Fred A. Norstadt and agricultural engineer Harold R. Duke, in cooperation with Colorado State University (CSU) Experiment Station, Fort Collins, Colo., conducted the study on commercial and experimental feedlots that did not have concrete floors. The Environmental Protection Agency also provided funds.

To gather data on water content and chemical movement, the researchers

Research assistant William R. Hand descends into a cased dry well carrying a vacuum bottle used in collecting water samples (0275X149–4).

Above: *Mr. Hand and Dr. Duke enter the access to a tunnel running through the center of an experimental feedlot at Colorado State University's Animal Science Research Center (0275X151–2).*
Right: *Inside the tunnel, Dr. Duke collects water samples that have percolated through the soil profile (0275X151–14).*

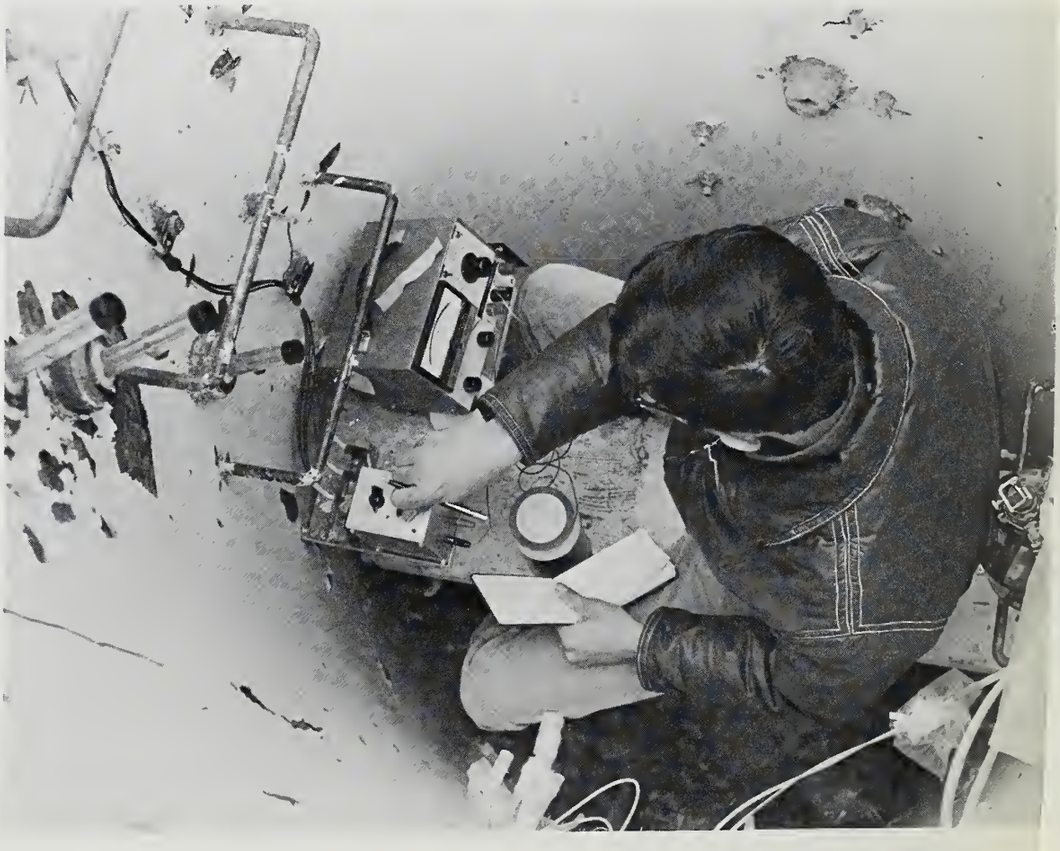
installed three cased dry wells in a feedlot. They used a similar well in a nearby alfalfa field for comparisons.

Nitrate nitrogen concentration was highest in the soil water near the manure-soil interface. This nitrogen concentration decreased markedly with depth; at 6 feet it was about the same as in the groundwater. Soil water samples from the well near the feed bunk had the smallest nitrate concentration.

Nitrate nitrogen content in the water table under each of the wells fell into the same range that the area had when first tested in 1912, before feeding operations were established—1 to 14 parts per million.

Dr. Norstadt theorizes that obnoxious odors produced by feedlots can be reduced and partially controlled by improved management practices. Two of the practices he suggests are using sawdust and woodchips for bedding and stirring the manure pack. In order to test what effect such practices would have on odors as well as water, salt, and nitrogen movement beneath a feedlot, a special experimental feedlot was built at CSU's Animal Science Research Center. Tunnels running beneath the lot permit the researchers to collect information from 16 rubber-lined soil pits. One year of testing has shown that proper feedlot management results in no pollution hazard to soil and water beneath the feedlot. □

Inside the cased dry well, Mr. Hand records ground temperatures to determine the effect of the well on the surrounding areas. Temperatures are taken at five depths and at six lateral positions along two of the five depths (0275X149–18).



Sunflowers shine on Texas High Plains

SUNFLOWERS—the source of a superior edible vegetable oil—appear to be adapted to the Texas High Plains where good yields were recorded in a 1-year study.

Total world production of sunflowers is about 3.7 million metric tons annually, making it the world's second most plentiful edible vegetable oil after soybean oil. The oil is very high in polyunsaturates and is comparable in some ways to corn oil. It is stable in storage, but not as stable as cottonseed oil. The meal is about 40 percent protein and is valuable for use in animal feeds.

In the Texas study, ARS soil scientists Paul W. Unger and Ordie R. Jones and agricultural engineer Ronald R. Allen, Southwestern Great Plains Research Center, Bushland, conducted three experiments with five cultivars—a variety named Peredovik (66), one commercial hybrid, and three experimental hybrids—under various irrigation and dryland management systems.

The researchers report that seed yield generally increased as the number of irrigations increased. Based on averages for all cultivars, a single irrigation at flowering resulted in a 247 pound per acre yield increase over those irrigated only for emergence. Three growing-season irrigations increased yields by 549 pounds per acre over seeds that received the emergence irrigation only.

Seeding rates and irrigation levels had slight but significant effects on total oil content of the seeds, with amounts ranging from as low as 38.6 percent for one hybrid to as much as 48.5 percent for another hybrid.

In the dryland management experiment, there were yield variations between sunflowers grown on plots established on summer-fallowed land and those grown on a conservation bench. Yields on the summer-fallowed plot ranged from a low of 680 pounds per acre to a high of 1,010 pounds per acre.

Yields on the conservation bench ranged from a low of 350 pounds per acre to 1,020 pounds per acre.

The wide range in yields among the four cultivars under dryland conditions can be attributed primarily to differences in plant populations and irregular seed emergence. The latter caused problems at harvest and reduced yield because seeds were lost from older plants while younger plants were not mature. Since the price per pound for sunflower seed was about three times that for sorghum, the high yield of 1,020 pounds of seed per acre compared favorably with grain sorghum yields of 1,800 pounds per acre on similar plots.

Sunflowers have a relatively short growing season of about 100 days, so they have potential for producing good yields following irrigated wheat in a double cropping system. This potential was studied in the third experiment using two tillage treatments—clean tillage and no tillage.

The sunflower plants emerged within 10 days. The fast growing sunflowers competed well despite a high population of volunteer wheat following hail damage, estimated at 20 percent, to the preceding wheat crop.

Yields of the two cultivars tested in the experiment were considered good. Peredovik (66) yielded 1,160 pounds of seed per acre in a clean tillage plot. The commercial hybrid used produced yields of 1,570 pounds per acre in the clean-till plot and 1,750 pounds of seed per acre in the no-till plot.

Many insect species were seen on the sunflowers, particularly after they had begun to bloom. However, the only significant insect damage was caused by snout beetles which girdled about 6 percent of the plants just below the heads in one experiment. Carrot beetles, which are severe insect pests of sunflowers in some locations, were not observed at Bushland during the experiments.

Also of interest is the fact that the sunflowers suffered very little damage in a hailstorm that stripped the leaves on grain sorghum and destroyed soybeans. □

Working inside one of the new pollination chambers, Dr. Hecker examines a flowering sugar beet for pollen sterility (0275X146–14).

Telescoping the generations

PLASTIC isolation chambers for flowering plants eliminate the need for plant breeders to space individual breeding plots one-third to one-half mile apart to prevent pollination by unwanted plants. The chambers thus make planting, maintenance, and harvesting easier and cut travel and fuel required for driving from plot to plot.

By building the relatively inexpensive chambers inside a greenhouse, scientists can also control temperature and humidity—important advantages during the dry winter months. "The chambers speed our research considerably," says ARS research geneticist Richard J. Hecker. "We can now collect three seed productions per year and experience no losses due to late spring or early fall frost. In addition, we can eliminate losses caused by insects, accidental herbicide drift of sprays and grazing by livestock or rabbits." In contrast, breeders relying on outdoor plots ordinarily can expect only one crop per year.

Dr. Hecker, with the help of plant pathologist John O. Gaskill, developed these chambers for their sugar beet breeding research at the Crops Research Laboratory, Fort Collins, Colo. They designed two different models—one for use in the field and one for use inside. Both proved effective.

The chambers for outside use have a portable wooden frame, 6 by 6 by 6 feet, covered with polyethylene sheeting. Each chamber is equipped with a pollen filter unit that has a separate blower. The fans blow filtered air continuously into each chamber. About one-third of the total chamber volume is expelled per minute through a 4-inch flutter valve near the top. A small fan in each chamber aids in pollen distribution.

A ¼-inch mesh wire screen stretched above all the chambers provides protection against damage by hail. One layer of plastic that provides 75 percent shade covers the wire screen.

Chambers for use inside have a frame made of welded aluminum and redwood strips; the frames measure 64 by 84 by 72 inches high. The scientists report maintaining temperature ranges of 60° to 65° F. at night, and 80° to 85° F. during the day. □

In a greenhouse containing four pollination chambers, Dr. Hecker moves pollen from pollen-fertile to pollen-sterile plants, resulting in the development of hybrid seed on the pollen-sterile plants. The pollen is moved with a pollen blower, which operates like a small vacuum cleaner in reverse (0275X146–22).

New fungicide for sugarcane

THIOPHANATE METHYL — TPM— may become the first general seedpiece fungicide for sugarcane in Louisiana, and should be commercially valuable in controlling soil-borne diseases. Seedpieces can be dipped in a suspension of the systemic fungicide or the roots of growing plants can be drenched with it before the cane is harvested for seedpieces.

Results from greenhouse experiments at the U.S. Sugarcane Laboratory in Houma, La., show that dipping sugarcane seedpieces in a suspension of TPM will dramatically increase germination. Plant pathologist Shawming Yang and physical science technician Faye Seaberg report that more than 75 percent of the one-node seedpieces treated with TPM and immersed in the spore suspensions of three surgarcane pathogens—red rot, black rot, and pineapple disease—germinated after planting in steamed soil. Less than 40 percent of untreated seedpieces germinated.

At 2, 4, and 6 weeks before harvest, whole stalks were harvested from plants growing in pots that had been drenched, soil and all, with 0.28 percent TPM. The pathogens used separately to inoculate the pots did not spread from the inoculation sites, but the pathogens did spread in untreated stalks.

Only 10 percent of one-node seedpieces germinated when potted in soils infested with all three pathogens, but 80 percent germinated after being immersed in 0.7 percent TPM suspension for 10 minutes, and then planted.

More than 90 percent of the seedpieces obtained from plants in drenched pots germinated, compared to less than 20 percent from untreated pots.

Currently TPM has been registered only for turf and stone fruits, but researchers anticipate registration for sugarcane, under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended, 1972. □

Overfeeding sows yields no benefits

SWINE PRODUCERS who believe in overfeeding pregnant sows may note with profit a Yugoslav study which clearly demonstrates the impracticality of such management practices.

Yugoslav researchers found that a high energy intake by gilts and sows resulted in excessive weight gains, primarily in the form of subcutaneous and caul (abdominal) fat. This fat is subsequently lost between farrowing and weaning without any positive productive results as measured in offspring performance.

ARS-cooperating scientist Lowell T. Frobish, Beltsville, Md., says, "The results proved that a 40-percent reduction in daily digestible energy intake would not affect reproductive performance."

Dr. Frobish added, "This research is impressive for its comprehensive testing—130 sows each per three separate dietary treatments for three reproductive cycles involving 2,167 weaned litters. There are few research centers in the United States that could handle such a large number of pregnant animals, and there are still fewer centers that could or would select gilts to determine if carryover effects from the dams to the progeny were present."

The Yugoslav scientists tested sows and gilts in three groups based on three different dietary treatments: 100, 80, and 60 percent of the U.S. National Research Council (NRC, 1959) *Minimum Nutrient Requirements for Swine.*

Their findings showed that a 60 percent NRC energy intake was preferable—provided the absolute daily requirements of other nutrients (protein supplement including necessary vitamins and minerals) were maintained. Gilts or sows receiving the lower energy intake consumed the same amount of protein, minerals, and vitamins as did the animals receiving the highest energy intake. This was made possible by changing the corn to protein supplement ratio in the diets. The result was a corresponding reduction in digestible energy and a savings in feed.

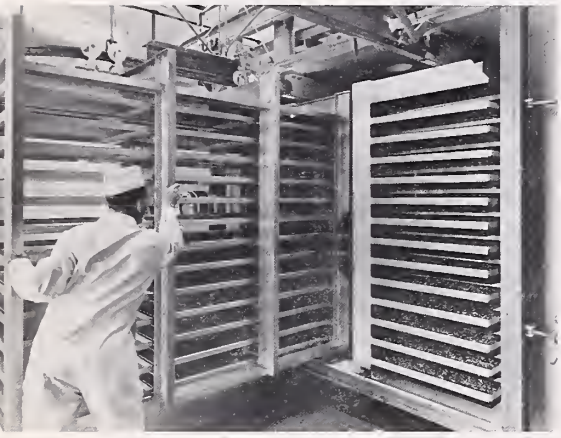
For example, under a dietary treatment of 100 percent NRC for gestating gilts, the diet would call for 70 percent corn and 30 percent protein supplement. At 60 percent NRC this would amount to 40 percent corn and 60 percent supplement. On a progressive dietary scale with sows, for example, in the last 25 days of gestation, the daily energy intake would be 10,300 kilocalories for the 100 percent NRC and 6,000 to 8,000 kilocalories for the 60 to 80 percent NRC levels.

Although the Yugoslav studies indicated that there was a reduction in weight gain of the pregnant animals receiving the lower energy intake, these animals lost less weight during lactation than those receiving the higher energy intake. The lower energy levels did not adversely affect the number and weight of baby pigs or the metabolic and reproductive efficiency of sows or gilts.

This project, conducted under the provisions of Public Law 480, was directed by Dr. Aleksandar Sreckovic at the Livestock Research Institute, Novi Sad, Yugoslavia. □

Longer Life for Stor

A technician at the Pennwalt Corp., King of Prussia, Pa., slides a rack of seeds into a commercial freeze dryer. The company cooperated with ARS on research to use freeze-drying techniques to extend the storage life of seeds (PN–2880).



JUST how believable are reports of ancient grain seeds found in Egyptian crypts germinating upon reaching the proper medium? Or of the 2,000-year-old Indian lotus seed, found in China, still viable and able to develop into a plant? Those seed stories may or may not be true, but this one is.

Freeze-drying of some vegetable seeds increases their storage life by at least four times that attained by conventional drying methods. Research by ARS and industry recently demonstrated the improved storability of onion, pepper, and parsley seeds through freeze-drying techniques.

Plant physiologist Lowell W. Woodstock and botanist Eltora M. Schroeder of the Beltsville Agricultural Research Center (BARC) stored freeze-dried and conventionally dried seeds at 77°, 104°, and 122° F. for 3, 6, and 12 months in sealed containers. Then, by comparing germination and seedling vigor, the scientists found that storage capability of the freeze-dried seeds increased.

The freeze-drying was accomplished with equipment similar to that used commercially for freeze-drying coffee at the Pennwalt Corp. in King of Prussia, Pa., and was supervised by senior chemist Joe Simkin. Director Richard Sayers, Asgrow Research Center, Twin Falls, Idaho, provided the seeds.

"The results of these tests are another step in man's progress toward realizing his ambition of storing seeds for very long periods of time," says Dr. Woodstock. This development, he adds, could help agriculture meet future world food demands in three ways.

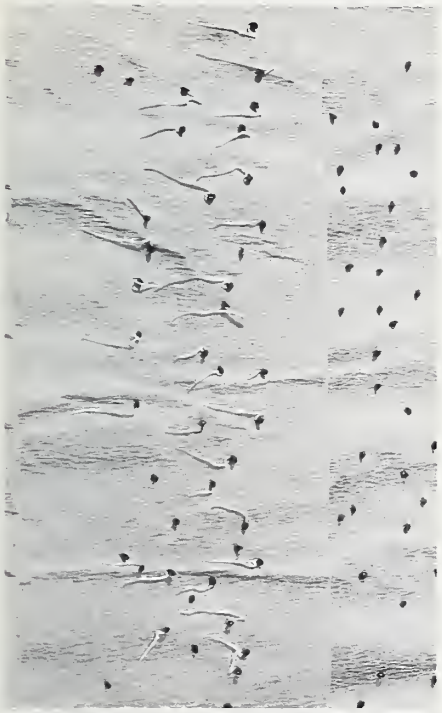
The first benefit can be read from the results of the 122° F. tests which show the greatest improvements: after 6

Miss Schroeder compares germination progress of freeze-dried and non-freeze-dried seeds inside a germinator—a heated chamber similar to an incubator (1174X1755–21).

months storage, germination of the freeze-dried seeds ranged from 66 percent for onion, to 81 percent for pepper, and 82 percent for parsley—but not one of the conventionally-dried seeds survived. This trend continued for onion parsley seeds after a year's storage: onion—freeze-dried 61 percent, normally dried 0; parsley—freeze-dried 74 percent, normally dried 0.

The freeze-dried seeds store better at warm temperatures. This could lead to improved storability in warm climates and better transport of seeds through the tropics, Dr. Woodstock says this could help developing countries in tropical climates to minimize problems of heat damage to seed left in storage, whether on farms or in central warehouses. World seed trade, in certain high-value species, could benefit from freeze-drying practices.

ed Seeds



A comparison of the freeze-dried seeds (left) and the non-freeze-dried seeds shows a marked difference in germination (1174X1756–33).

A second potential benefit is that freeze-dried seeds will probably store better at moderate and even low temperatures, which means longer seed storage life in marketing channels. The improved storage found in the 12-month, 122° F. tests might be duplicated at lower temperatures for a longer period because even the non-freeze-dried seeds did not die after a year at lower temperatures.

Longer term tests with onion, pepper, and parsley seeds are underway in cooperation with plant physiologist Louis N. Bass, head of the National Seed Storage Laboratory, Fort Collins, Colo.

The third benefit focuses on better preservation of germplasm. Superior plant characteristics from genetically diverse germplasm may be lost through repeated seed increases. Thus, freeze-drying would aid plant breeders and the National Seed Storage Laboratory where seed germplasm collections are maintained for developing new crop varieties. The practice would minimize the frequency of multiplying germplasm seed sources to maintain viability.

The studies at BARC showed that dry seeds are not injured by freeze-drying. But seeds of very high moisture content—over 9 or 10 percent in pepper and parsley—may be injured or killed by freeze-drying. Seeds of these crops must first be dried conventionally to moisture levels below 9 percent.

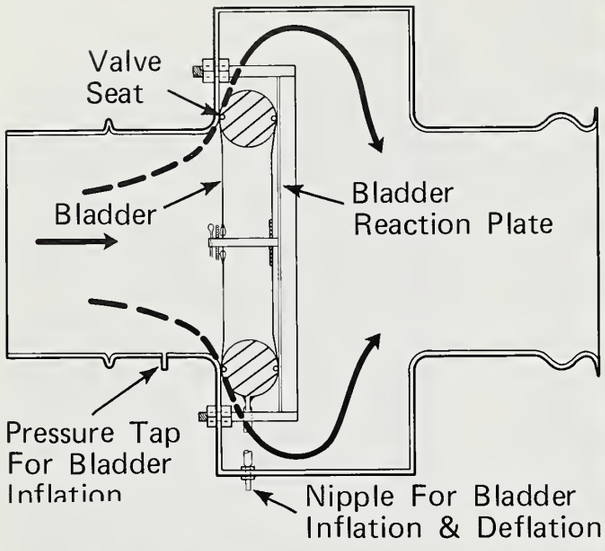
Whereas conventional drying includes the use of some heat which tends to injure seeds, freeze-drying techniques can lower seed moisture from "normal" air-dried levels of 7 to 9 percent to levels of 2.5 to 5 percent without additional heating.

Dr. Woodstock and Mr. Simkin suggest that freeze-drying may selectively remove certain water layers by sublimation of ice crystals while leaving water essential for good storage. Some water is necessary to protect enzymes and membranes from oxidative reactions which may injure the seeds.

While these data clearly demonstrate a beneficial effect of freeze-drying seeds for storage at warm temperatures, the conditions and duration of freeze-drying, and the optimal seed moisture content must still be determined for each kind of seed. □

Joseph Simkin, research chemist for the Pennwalt Corp., places a tray of seeds in a commercial freeze dryer (1174X1754–7).

Dr. Woodstock and Miss Schroeder record the number of germinated seedlings from groups of freeze-dried and non-freeze-dried (foreground) seeds (1174X1756–9).



***Above:** A schematic drawing of the bladder valve shows the bladder inflated, sealing off the water flow. When the bladder is deflated, water flows around it as indicated by the broken line and arrows (PN–2881). **Right:** Agricultural engineer James Bondurant checks crops irrigated with an automated gated pipe control system. With this new control system fields can be divided into several sub-runs which enable water to travel shorter distances in smaller stream sizes thus helping to reduce run-off and erosion (0874X1357–37).*

Better control of farm irrigation

WHAT'S NEW in farm irrigation? Recent research indicates that use of gated pipe surface irrigation systems with automatic low-pressure valves can better control farm irrigation water. The new system increases crop productivity and reduces sediment pollution.

More and more farmers are using gated pipe—pipe with adjustable gates that open to discharge water—in their irrigation systems. Gated pipe offers a convenient means of evenly distributing irrigation water throughout a field. By automating gated pipe systems, fixed amounts of water can be delivered to the soil at a controlled rate of flow, avoiding excessive and wasteful use of water that only harms crops and washes away the soil. In addition to increased irrigation efficiency, an automated system also reduces the amount of irrigation labor.

To automate gated pipeline systems, ARS agricultural engineer Allan S. Humpherys and technician Robert L. Stacey, Snake River Conservation Research Center, Kimberly, Idaho, developed valves and controls that govern the sequence of water flow from one set or section of pipe to another.

The valves come in three sizes: 6-, 8-, and 10-inches; and operate with water from the irrigation pipeline at pressures up to 12 pounds per square inch. Water-inflatable bladders consisting of a modified, small tire inner tube, supported on either side by a rubber membrane are used to open and close the valves.

When filled with water supplied from a tap on the upstream side of the valve, the bladder expands and closes the valve by sealing its flow area. Draining the bladder allows the force of the water flowing through the pipes to flatten it and open the valve.

A three-way selector valve, powered by battery, controls the filling and emptying of the bladder. The selector valve can be activated by electronic or mechanical timers, commercial irrigation controllers, or radio transmitter-receiver units.

The automatic valves were field-tested with gated pipe to successfully irrigate corn, employing an experimental electronic timer also developed by ARS. Later, the valves were used with a commercial irrigation controller to irrigate beans with short, frequent applications of water. This test also proved successful. □

The heart of the automated gated pipe irrigation system is this small battery-powered pilot control. The bladder unit is located in an enclosure adjacent to the control (0874X1357–33).

Soil scientist Warren Rasmussen (left) and Mr. Bondurant program irrigation sequences on a commercial electronic controller. This unit can "tell" a series of 12 battery-powered pilot valves when to open and close (0874X1357–37).

Soybean flowers and bees

HONEY BEES may pollinate soybeans and increase yields of some varieties while other varieties are scarcely affected. ARS scientists are studying this phenomenon in the hope of learning to employ honey bees more productively on soybeans.

Soybeans, which are usually self-pollinated, were previously thought to benefit little from the bees' visitations. However, ARS entomologist Eric H. Erickson, Wisconsin Agricultural Experiment Station, Madison, Wis., observed that in caged soybean plots, bees increased yields of Corsoy and Hark varieties by 14 and 16 percent, respectively. Dr. Erickson says other soybeans may be found that benefit even more from bee pollination.

Now, in cooperation with the station, Dr. Erickson is screening several hundred varieties and breeding lines of soybeans for their attractiveness to honey bees, and for their potential for sustaining higher yields through bee pollination. Cataloging these soybeans, while taking into account other economically desirable qualities, will help plant breeders as they develop new varieties.

The research will especially enhance breeding programs that require use of hybridization, a process that was recently made feasible for soybeans through a discovery by ARS agronomist Charles A. Brim and his colleagues at the North Carolina Agricultural Experiment Station, Raleigh. That team discovered a male-sterility characteristic in soybeans which they used to develop a male-sterile line. Without the bee's help, however, soybean hybridization requires tedious, expensive, and time-consuming hand pollination.

With the bee's help, hybrid soybean seed may some day be used for growing soybeans commercially, as well as for plant breeding, if hybrids prove to have yield advantages. With a view toward improving the efficiency by which hybrid seed may be produced, Dr. Erickson is studying basic behavioral characteristics of honey bees and the possibility of breeding them to prefer visiting soybean flowers more dependably than most bees do now.

In his comparisons of three soybean varieties—Corsoy, Chippewa 64, and Hark—he noted that the bees foraged nectar most frequently from Hark soybeans, which have showy flowers. At pollination time, these flowers are nearly always open with pollen and stigmas exposed. The stigma is a part of the flower that is fertilized with pollen.

Hark soybeans also produced the greatest amount of nectar, which contained a higher precentage of dissolved solids than did nectar from alfalfa.

The bees picked up no measureable amounts of pollen from Chippewa 64 soybeans. Accordingly, they did not improve soybean yields of that variety. Apparently, the Chippewa 64 soybeans were self-fertilized even though their flowers never opened—a characteristic called cleistogamy.

Chippewa 64 and a genetically similar variety, Clark, are probably not cleistogamous in the southern part of the Midwest, Dr. Erickson says. In Wisconsin, 1 or 2 days of warm weather may cause them to give up their cleistogamy. Soil conditions may also affect the characteristic. □

'Optimize that skip'

Left: A wide-bed twin drill planter plants three pairs of cotton rows simultaneously, with each of the six rows containing two drills spaced 7 inches apart (0874K1394–35). Below: A high-clearance sprayer, modified for wide-bed spacing, covers three beds of six rows with each pass through the field (0874K1395–11A).

LIKE the old trouper who becomes a star overnight, a profitable new wide-bed cultural system for cotton is the result of 10 years of fundamental research, engineering, and testing. According to ARS studies, the new star lives up to its billing.

At a time when rising costs for labor, equipment, and material greatly concern the cotton farmer, and when competition with foreign growers and synthetic fiber manufacturers is a constant challenge, the wide-bed system can provide substantial production savings. Wide-bed culture requires less energy and material input per acre and maintains cotton yields comparable to those of solid planting.

The new technique evolved from both minimum-tillage and skip-row concepts. Historically, the skipped rows (wide middles) were not counted in acreage allotments. Now they are included and considered important. The object of the wide-bed system is to "optimize that skip," says agricultural engineer J. Ray Williford at the Field Crops Mechanization Research Laboratory, Stoneville, Miss. "To do that, we need to plant less seed per acre, in fewer rows per acre, using less machine-power per acre."

Wide-bed culture is based on the establishment of an unbalanced pattern of rows planted alternately 40 inches apart and 60 inches apart, with differential treatment of the tillage and traffic zones. This row arrangement requires only 10,455 linear feet of row per acre, compared with 13,068 feet for conventional 40-inch row spacing—a reduction of 20 percent.

Cultural practices used during the wide-bed studies included subsoiling in the fall, chisel plowing in the spring, and then bedding—plowing to elevate the surface soil into a series of parallel beds. Eighty to 100 pounds of nitrogen per acre were applied at bedding in most years. A stubble mulch procedure was followed for conventional 40-inch patterns, and a modified minimum tillage program for wide-bed was used in 1971–74. These practices are recommended by the engineers for farm use.

Careful selection of the width of the middles may be crucial, says agricultural engineer Floyd E. Fulgham, a pioneer in the wide-bed cultural system. If row width is increased 25 percent (from an average of 40 inches to an average of 50 inches), yields per linear foot of row must be increased by an equal amount to obtain the yield levels per acre obtained with 40-inch rows.

Scientists are now asking related questions. On what soil types are acceptable yields possible? Will it be necessary to vary the size of the wide middles on different soil types? What is the year-to-year yield variability compared with yield for 40-inch rows and other commonly used skip-row systems?

Answers to these and other questions appear to be implicit in continuing cooperative research and analysis at the ARS Stoneville laboratory and the Delta Branch of the Mississippi Agricultural and Forestry Experiment Station. □

Short-season Cotton vs. Late Fall Rains

COTTON FARMERS in the Lower Rio Grande Valley of Texas, like their counterparts elsewhere, have problems—late season rains that cause spotting, boll rot, and rising production costs.

One answer to these problems in the Valley may lie in shortening the growing season by using early maturing cotton and an early July defoliation date, report ARS soil scientists L. Neal Namken and Marvin D. Heilman of the Soil and Water Research Laboratory at Weslaco, Tex.

Working with high populations of four early maturing cultivars planted in medium-textured soils, the scientists estimate that defoliation in the first week of July may reduce yields somewhat, but that gains in production efficiency may offset the reduction.

The cottons used in the study were three determinate cottons, Paymaster 266, Paymaster Dwarf, and Acco 1764, and a standard nondeterminate, TPSA 110. Determinate plants bloom about a week earlier and fruit heavier soon after first bloom than the conventional cultivars. These characteristics permit a given yield to be set in a shorter production season.

All cultivars were planted late in February in double rows 10 inches apart on 38-inch centers at rates of 81,000 to 89,000 plants per acre. The plots were irrigated the day after planting and once again about 90 days later.

By making bloom counts, assuming 60 percent boll set, and taking boll size from later measurements, Dr. Namken and Dr. Heilman calculated potential yields for early harvest with a July 3 defoliation. Estimates of lint yield per acre were: 932 pounds for Acco 1764; 866 pounds for Paymaster 266; 654 pounds for Paymaster Dwarf; and 609 pounds for TPSA 110.

A single study was conducted with Acco 1764 to determine if the potential yields are feasible with an early harvest. Defoliation 108 days after planting yielded 436 pounds of lint per acre, 118 days after planting yielded 903 pounds, and 128 days after planting yielded 901 pounds.

Although lint yield was good when defoliation was effected 118 days after planting, micronaire, a measure of maturity, was a low 2.4 and fiber length was 1 inch. When defoliated at 128 days, micronaire was an acceptable 3.6 and fiber length $1\frac{3}{32}$ inches. Thus defoliation 130 days after planting is feasible for the cultivaters adaptable to short season production.

Boll weevils, bollworms, and tobacco budworms are the major insect enemies of cotton in the Valley. Many cotton farmers apply insecticides as many as 12 times during May, June, and July and achieve varying degrees of control. Thus any innovation in production such as early harvest would be a step toward reducing both production costs and environmental deterioration.

Also important is how well early harvest would fit in the Valley's long-term rainfall pattern which indicates rain probability increases sharply about August 1 and continues to increase past the mandatory September 1 pink bollworm control plowup deadline.

Determinate cottons can be expected to be ready for defoliation in early July and be harvested by August 1. Nondeterminate cottons such as the widely used Stoneville 213 are normally defoliated about August 1. Harvesting is frequently slowed by rains, making it difficult for growers to meet the plowup deadline.

The early-maturing, determinate cottons have been developed primarily for use in narrow row-high population systems with once-over stripper harvesting. This causes problems under Valley conditions.

The problems include getting the cotton stalks dry enough for harvesting with available stripper harvesters, large stalk size in rainy years, and cotton with root rot. Under these conditions, determinate cotton varieties have been successfully spindle picked when the cotton was planted double-row with the rows being no more than 8 inches apart on 40-inch beds.

If the harvest problems can be solved—and several companies are working on them—use of determinate cottons in an early harvest management system could significantly increase management flexibility and reduce production costs. □

Nitrapyrin limits severity of stalk rots

A NEW CHEMICAL COMPOUND, nitrapyrin, that was developed to preserve availability of nitrogen for plants, may also reduce severity of some destructive corn diseases—stalk rots.

This observation was made in research conducted by ARS plant pathologist Herman L. Warren and his colleagues of the Purdue University Agricultural Experiment Station, West Lafayette, Ind.

Nitrapyrin is a nitrification inhibitor—it slows the process in which nitrogen in the ammonium form is converted to the nitrate form. Because nitrates from fall-applied fertilizers may leach from the soil or be converted to atmospheric nitrogen gas before they can be utilized by crops, Dr. Warren says, slowing the formation of nitrate can save dollars now invested in fertilizer.

The scientists conducted their studies on two southwestern Indiana soil types—Kings silty clay loam and Elston fine sandy loam. They found that corn fertilized with nitrapyrin-stabilized nitrogen produced stalks that did not break as easily as those stalks grown on soil that received only nitrogen or no nitrogen at all.

Roots and stalks of the weaker plants were seriously infected with the disease organisms *Diplodia* and *Gibberella*. The researchers also observed that another rotting organism, *Fusarium moniliforme*, was more prevalent on grain produced on silty clay without nitrapyrin than it was on other plots.

Kings silty clay loam soil treated with one-half pound of nitrapyrin and 119 pounds of nitrogen per acre yielded 63 more bushels per acre than soil that was fertilized without the nitrogen stabilizer. Dr. Warren attributed the higher yield mostly to availability of nitrogen for the plants, although severity of stalk and root rot was probably a factor also.

For years, agronomists have recommended balanced soil fertility as a means of reducing stalk rot damage. They have believed that high levels of nitrogen and low levels of potassium are associated with the complex disease.

Dr. Warren says that muriate of potash (potassium chloride) is commonly used throughout the Midwest to combat the disease problem. Chloride ions—electrically charged atoms—in the muriate of potash restrict plants from taking up nitrate nitrogen. Nitrapyrin, or 2-chloro-6-(trichloromethyl) pyridine, might function in a similar manner, he says. □

Bacterial Sun Spot

INTRIGUING and still mysterious, "Bacterial Sun Spot" is a new disease of sweet sorghum and sugarcane. Plant pathologist Natale Zummo and agronomist Kelly C. Freeman chose descriptive nomenclature for the spot—it appears to be caused by bacteria and has a sun-colored reddish center.

Researchers further describe it as "obvious, unusual, circular to long elliptical, and brown-red with tan centers." Generally found on the upper leaves of the plants, the spots ranged from minute to slightly less than an inch in length; the largest were roughly ¾ of an inch wide and 2 inches long.

On sugarcane the spots were smaller and there was a "halo" or light ring around the lesions, and in some instances a streak similar to, but shorter than, those of the disease "eyespot." "We do not yet know precisely what it is or when or how it moved in," said Mr. Freeman. Again speaking graphically, the scientists said that on both sugarcane and sweet sorghum "an abundant bacterial ooze on the undersides of the spots glistened like droplets of blood."

Is Bacterial Sun Spot as threatening as it sounds? Apprehensive at first, scientists now can say it holds no potential hazard for humans or animals. However, economic effects of the disease have not been assessed. Though no sugarcane variety showed any visible loss due to the disease, research revealed that all of several thousand samples of commercial and unreleased varieties were affected to some extent. On some varieties of sweet sorghum 25 percent or more of the leaf area was covered with bacteria-laden spots. Although extremely widespread in its initial appearances in 1973, the prevalence of the unpredictable disease appeared to be very scattered in 1974.

The identity of the small rod-shaped bacterium has not been fully determined, but its cultural and morphological characteristics tend to place it in the genus *Pseudomonas*. Isolated from spots on sugarcane and sweet sorghum, the bacterium was motile, white in culture, and gram negative (a method of identification by staining) with methyl blue. It stained readily with carbol gentian violet and grew rapidly on potato dextrose agar at 35° C.

Inoculating plants in the greenhouse, researchers transmitted the disease to sugarcane plants by pouring a small amount of bacterial agar suspension into the leaf whorls. When small pieces of sugarcane leaves containing a sun spot with bacterial ooze were taped to leaves of healthy sugarcane plants, the disease was also transmitted.

These investigations are being pursued by Dr. Zummo and Mr. Freeman at the U.S. Sugar Crops Field Station in Meridian, Miss. The leaf spot disease had also been observed on sweet sorghum at Weslaco, Texas, and on sugarcane at Houma, La. □

Pesticide sprayer modifications

PESTICIDE APPLICATIONS by conventional spray equipment can now be regulated with greater precision by an automatic control system that changes nozzle pressure as tractor speed varies.

An arrangement for controlling application rates this way was studied by ARS agricultural engineer Maurice R. Gebhardt and his colleagues of the Missouri Agricultural Experiment Station at Columbia. The system may reduce pesticide waste, environmental pollution, and crop damage.

Until now, spray operators have tried, with difficulty, to meter pesticides accurately by maintaining constant groundspeed, having first calibrated their sprayers at that same groundspeed, says Dr. Gebhardt.

In testing their automatic control system, the researchers varied groundspeeds between 2 and 4 miles per hour and found that the volume of dispensed spray varied between 18.1 and 16.8 gallons per acre. Without the system, volume varied between 28.6 and 14.2 gallons. Dr. Gebhardt said, "Our most encouraging finding was that, with the system, speed had little effect on uniformity in spray distribution patterns."

The need has become great for distributing sprays uniformly and metering them accurately with the development of modern pesticides, Dr. Gebhardt says. Some of these pesticides are potent and must be applied with precision to kill pests while not damaging crops or killing beneficial insects.

Dr. Gebhardt and his colleagues are studying technology with a view toward spraying biological pest control agents as well as chemical pesticides.

The automatic control innovation includes a tachometer generator, amplifier, gear-motor, metering valve, and potentiometric pressure transducer in a closed-loop, direct-current system.

Plant spacing and wind erosion

CROP PLANTS spaced an equal distance apart instead of planted in rows would give uniform protection against erosion, regardless of wind direction.

More important, studies by ARS agricultural engineer Leon Lyles and research assistant Bruce E. Allison show that equidistant spacing of crops would provide the maximum wind erosion protection of rows oriented at right angles to the wind.

At best, crop rows planted more or less at right angles to the direction of prevailing winds offer only part-time protection. All erosive winds seldom come from the same or opposite direction. Prevailing wind direction is often ignored in order to plant on the contour or because of farmer preference for other reasons.

Dr. Lyles simulated the wind erosion protection from crop plants in wind-tunnel studies at Manhattan, Kans., in cooperation with the Kansas Agricultural Experiment Station. He represented plants with 1, 2, 9, or 36 wood dowels or wires per square foot and arranged them in rows parallel to the wind direction, in rows at right angles to the wind, or spaced an equal distance apart.

The engineer evaluated erosion protection on the basis of the critical friction-velocity ratio, a mathematical relationship between factors associated with resistance to movement of erodible soil particles and windspeed. Erosion begins when the ratio is exceeded.

Dr. Lyles found that erosion protection was comparable whether the same number of simulated plants were spaced an equal distance apart or in rows at right angles to the wind. The two arrangements were equally effective for the four simulated plant densities and heights up to 17 inches. Both gave more protection than rows parallel to wind flow, and their advantage increased with height, diameter, or density of simulated plants.

Is equidistant planting practical? Dr. Lyles acknowledges it would make planting, harvesting, and weed control more difficult without changes in present equipment and management practices. He notes that limited research indicates yield increases with equidistant planting for corn and soybeans but not with grain sorghum. Should further research confirm yield and erosion control advantages, commercial development of equidistant plant spacing systems might be stimulated.

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AGRISEARCH NOTES

Tobacco budworm sterilization

AN INEXPENSIVE, biological one-two punch may be on the way for controlling tobacco budworms and possibly other insect pests of economic importance.

A common problem in insect sterilization programs is finding treatments that will produce the desired level of sterility without reducing sexual competitiveness, mating frequency, and longevity of the males; and the oviposition and longevity of the females.

ARS entomologist Antonio A. Guerra, working at the Cotton Insects Research Laboratory at Brownsville, Tex., is using two substerile treatments administered at different stages of insect development to achieve sterility.

The treatment involves rearing pupae on a diet laced with a substerile amount of a chemosterilant followed by a substerile dose of radiation 24 to 48 hours before emergence.

Advantages of the dual treatment include sterile insects that are more vigorous and competitive, and a procedure that is readily adaptable to a mass-rearing program.

Dr. Guerra and his colleagues first tried the dual treatment in 1971, and although it worked, the chemical that they tested, reserpine, was difficult to obtain in large quantities and was costly. He then began a search for other sterilizing chemicals that would be just as effective without running treatment costs too high.

In recent research, five chemosterilants used with two different levels of radiation seemed promising. None of the combinations greatly affected larval development, emergence as an adult, or adult longevity, according to Dr. Guerra.

The egg-laying potential of the treated females was affected, Dr. Guerra said, but mating capacity was not affected as much as that of the treated males. This characteristic of the female could be critical when females are to be the sex released. Dr. Guerra points out, however, that considering the high cost of sexing large numbers of insects, any method that yields a competitive sex and a noncompetitive sex could be desirable in a sterile release program in which both sexes are to be released.

Silverleaf nightshade control

ANOTHER BLOW has been struck for biological pest control. Three scientists have found that infestations of silverleaf nightshade, an increasingly bothersome weed in southwestern cotton fields, can be greatly reduced by a parasitic nematode, *Nothanguina phyllobia.*

In addition to being an economically important weed pest, silverleaf nightshade is also difficult to control with herbicides presently used for cotton. As a result it has spread rapidly.

Using isolated samples from natural infestations, ARS scientists Calvin C. Orr and Elmer B. Hudspeth, Jr., and Texas Agricultural Experiment Station scientist John R. Abernathy artificially infested silverleaf nightshade plants. The artificially inoculated plants developed severe nematode galls just as occurred in natural infections.

Parasitized plants are either stunted or killed. Those plants that continue to grow, lose leaves and fruiting structure, and therefore produce fewer seeds.

Artificial inoculation of 11 other common plant species under both field and growth chamber conditions resulted in no infection. This suggests that the nematode is host specific and has definite possibilities of being developed as a biological control mechanism for silverleaf nightshade or integrated into an effective control program in combination with chemicals or cultural practices. The research was conducted at Lubbock, Tex.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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